

# Construction and evaluation of interactive educational technology for family members acting as caregivers on caring for dependent people\*

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## ABSTRACT

This study aimed to describe the process of constructing and evaluating an interactive educational technology for family members acting as caregivers who care for dependent people to ensure continuity of care after hospital discharge. This is an applied research, descriptive exploratory, developed between 2012 and 2013. The educational technology construction based on the ADDIE model, which in turn based on the Contextualized Instructional Design. Six experts evaluated the technology with a questionnaire with closed and open questions. The educational technology contains information, guidelines, photos, videos and audio, structured by three themes related to feeding by tube, positioning and transferring. The experts positively evaluated the educational technology, approved its content and made suggestions for its improvement. Educational technology was adequate to provide reliable information, adapted to the needs of the family members acting as caregivers, and could be a facilitating platform to assist them in the self-care context of the dependent people.

**Descriptors:** Education, Nursing; Educational Technology; Education, Distance; Nursing Informatics..

## INTRODUCTION

In the current context, technology is advancing at an unprecedented speed, reaching remote, hard-to-reach regions around the world. However, it should be capable of producing changes in the development of countries facing enormous challenges in terms of economic and health situations. Thus, public policies point to the development of Information and Communication Technologies (ICT) in the health area as a strategic

axis. In this context, the Internet is increasingly a privileged means of communication and information used to interact with the population in need of health care<sup>(1)</sup>.

The creation of strategies that promote access to care either directly or by means such as the internet that adapt to the real needs and values of people, enable them to make free, responsible and informed decision-making and facilitate free access to care information and clinical knowledge, are now a priority health target<sup>(1)</sup>. ICTs show new opportunities and challenges for educators and users and stimulate various changes in the most varied areas of knowledge, promoting a considerable impact on the teaching/learning process<sup>(2)</sup>.

The digital technologies favor an innovative teaching by allowing the development of competences and consequently a greater autonomy of the users' decision-making. Among these technologies, learning objects (LO) stand out for being reconcilable with active and constructive teaching/learning methodologies and for forming a new paradigm of instructional learning design supported on the web and characterized by reuse<sup>(3)</sup>. LO also facilitate the communication between individual and computer with the use of multiple means of representing information such as texts, images, sounds, animations and videos<sup>(4)</sup>. Applying multimedia environments through the construction of platforms as complementary tools to the teaching provided by healthcare professionals to clients and families is relevant, which aims to improve teaching with the new technologies. In Portugal there is a greater citizen involvement in health decisions; on the other hand, healthcare professionals need clinical information to be present at the time and place where it is most needed, making information an essential resource for quality of care<sup>(5)</sup>.

The goals for Europe (2014-2020) focus on investment by entrepreneurs, business leaders, managers and users in ICT promotion with a focus on their strategic use<sup>(6)</sup>. Building the "Innovation Union" has become one of the flagship initiatives of the Europe 2020 strategy. The 2014 report<sup>(7)</sup> states that the initiative success depends not only on greater efficiency of public policies, but also on locally developing conditions to stimulate European companies to innovate. The European Innovation Partnership on Active Healthy Aging (EIP-AHA) has resulted from the challenges posed by the European Union in the Europe 2020. The EIP-AHA pursues a triple win for Europe: a better life, with active aging and independent living for the elderly, the sustainability of social systems and health systems and the improvement of the competitiveness of the European industry through new Markets.<sup>1</sup>

The main challenge for Portugal in Research and Development is to ensure the sustainability of the Research and Innovation (R&I) system in order to increase the innovation/development share of companies in the region. One indicator relates to growth through technology (patents)<sup>(7)</sup>.

Health technologies progress has led to the need to introduce changes in the professional contexts, particularly in the nursing area, and has gone through the development of Virtual Learning Environments (VLE). It has become necessary to invest in the adoption of distance education techniques that facilitate and

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<sup>1</sup> Link: [http://ec.europa.eu/research/innovation-union/index\\_en.cfm?section=active-healthy-ageing&pg=about](http://ec.europa.eu/research/innovation-union/index_en.cfm?section=active-healthy-ageing&pg=about).

promote self-learning and require the implementation of these methodologies in different organizational contexts, health institutions and teaching. There is evidence of the impact of ICT application on quality of care and cost reduction<sup>(8)</sup>. Educational technologies are important information therapy strategies. When used as a therapeutic education strategy by the nursing professional, they should consider the accessibility and the intrinsic characteristics of the technological supports and the provided information<sup>(9)</sup>.

Nowadays, families provide increasingly more complex care to the dependent people. In the current health system it is important to develop formal knowledge, empowering family members acting as caregivers with essential resources for acquiring knowledge and skills in caring for the dependent people at home. Nurses should monitor and maintain a coaching relationship so that family members acting as caregivers develop the skills<sup>(10)</sup>; brief periods of guidance are no longer sufficient. There is a growing ICT use by the general population that seeks information on health issues. Some of the gains in the construction of interactive electronic tools relate to the fact that there is no need to go to a health facility and to the free information access<sup>(11)</sup>. In addition, after the instruction given by the professionals to the caregivers and in logic of complementarity, the caregivers can access the information relevant to their learning needs in a flexible way.

This article aims to become part of the project that has the goal to contribute, through educational technologies, to the development of knowledge and skills of family members acting as caregivers. It aligns with the *EIP-AHA* and is part of the C2<sup>2</sup>- *Development of Interoperable Independent Living Solutions of the European Commission*, committed to contributing to the production and implementation of tools/guidance to the users' training, incorporating co-creating, sensitizing and building reliable and user-friendly tools. The construction of the interactive tool "Caring for Dependent People" used low cost technology to develop a platform for family members acting as caregivers of dependent people in order to ensure continuity of care after hospital discharge.

The study is based on a descriptive exploratory applied research, adopted as it is a process of development of an interactive educational technology. This study aimed to describe the process of constructing and evaluating an interactive educational technology for family member acting as caregivers who care for dependent people to ensure continuity of care after hospital discharge.

## METHOD

The study bases on a descriptive exploratory applied research, for being a development process of an interactive educational technology. An applied research aims to solve concrete or immediate problems or needs<sup>(12)</sup>. The Research Coordination Office (DEFI) and the Ethics Committee of the Hospital of Porto (CHP) approved the project under No. 157/11 (107-DEFI/137-CES); the study followed the conduct rules mentioned in the declaration of Helsinki and in the current Portuguese legislation, ensuring the confidentiality of the

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<sup>2</sup> Link to access the action plan: <https://webgate.ec.europa.eu/eipaha/library/index/show/filter/actiongroups/id/787>.

data collected. This study was developed at the Nursing School of Porto (ESEP) in partnership with the Higher Institute of Engineering of Porto (ISEP) between 2012 and 2013. Professors who agreed to participate in the study signed the Free and Clarified Consent Term.

The research based on the development of an interactive educational technology in order to provide information adapted to the needs of family members acting as caregivers of dependent people. The study has two parts: the methodology of educational technology development and its evaluation by experts, professors with master or doctorate degrees in this area of study.

The methodology to develop this educational technology based on the ADDIE model based on the *Contextualized Instructional Design* (CID)<sup>(13)</sup> and consists of five phases, analysis, design, development, implementation and evaluation.

In the *analysis* phase, the characterization of target audience, choice of themes, definition of educational objectives and definition of the contents, as well as the analysis of the technological infrastructure for the development, implementation and LO maintenance occurred. The content definition would include previously defined objectives aimed at assisting family members acting as caregivers in the provision of care to the dependent person on self-care related to 'nasogastric tube feeding', 'positioning' and 'transferring'.

In the design phase, the instructional design was defined, involving the planning and production of educational contents, definition of the educational modules, media choice (texts, images, figures, and videos), navigation structure and the interface design. In order to create this technology, studying the various technological resources available on the Internet was essential, including MedlinePlus<sup>(14)</sup>, since it contains carefully selected links and has a varied encyclopedia with images and videos on health topics. We adopted the conduct rules of the *Health On The Net Foundation*<sup>(15)</sup>.

The *development* phase consisted of the materialization of all the designs elaborated in the previous phase. LO was built in the program *Adobe Captivate6*, allowing the integration of all interactive animations. Images were created and edited in the *Adobe Photoshop CS5* and *Adobe Illustrator CS5*. The audio was captured and edited through specific applications as *Cubase* and *Adobe Premiere Pro*.

The research had the collaboration of a Masters' degree student of Computer Graphics & Multimedia Engineering of the Higher Institute of Engineering of Porto (ISEP), to respond directly to the educational technology regarding the study. The collaboration provided by the University of São Paulo (USP- Brazil) allowed us the use of interactive didactic computer resources such as Virtual Man<sup>(16)</sup> using the pressure ulcer prevention module. In its development, physical resources were necessary to develop the videos (technical rooms of ESEP), technicians (computers, cameras, medical equipment) and human (volunteers to make videos and computer technicians).

The *implementation* phase comprised the configuration of the technological and educational resources and tools, allowing access to this interactive tool through the internet. LO was hosted on the ESEP server.

The *evaluation* phase involved assessment by a group of experts. The intention was to obtain an

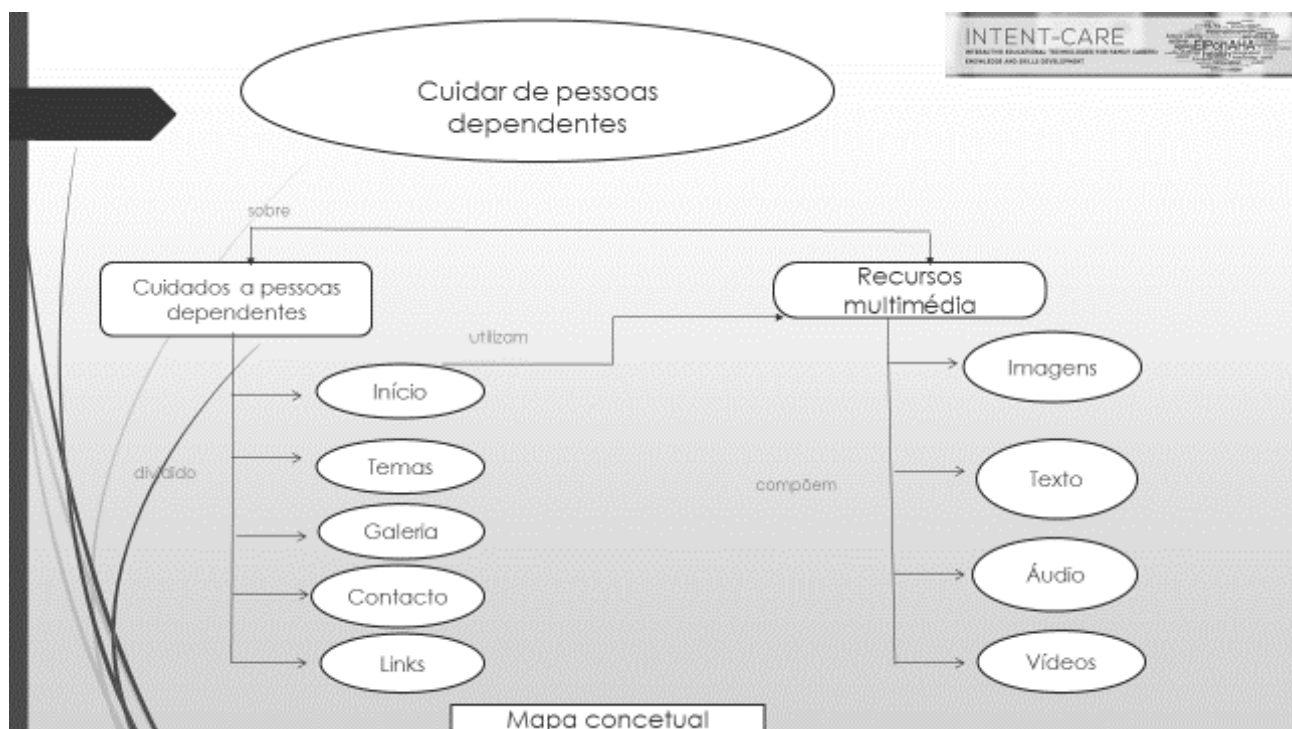
opinion on the relevance of the interactive tool content, the algorithm suitability and the logic of navigation of the eight experts initially invited; six of them concluded all assessment process.

The assessment questionnaire was adapted from other tools validated in other studies<sup>(17-18)</sup>. The questionnaire included sociodemographic variables such as age, gender, professional practice time, academic qualifications, professional title, and 12 closed questions in which the evaluator, through a measurement scale of one to 10, evaluated the design, page loading, utility, ease of navigation, clear and objective organization, photos and figures, videos, audio, content, and writing correction. In order to evaluate the detection of some error or problem and point to suggestion of improvement, the questionnaire had two open questions. Data analysis was performed using descriptive statistics.

## RESULTS

The creation of the educational technology "Caring for Dependent People" for family members acting as caregivers, followed the ADDIE model based on the CID<sup>(13)</sup> and is hosted on the ESEP server, link: <http://online.esenf.pt/cuidarpessoadependente/>.

The conceptual map of educational technology presents different functionalities and was designed with the intention of being simple and objective (Figure 1).



### Legend:

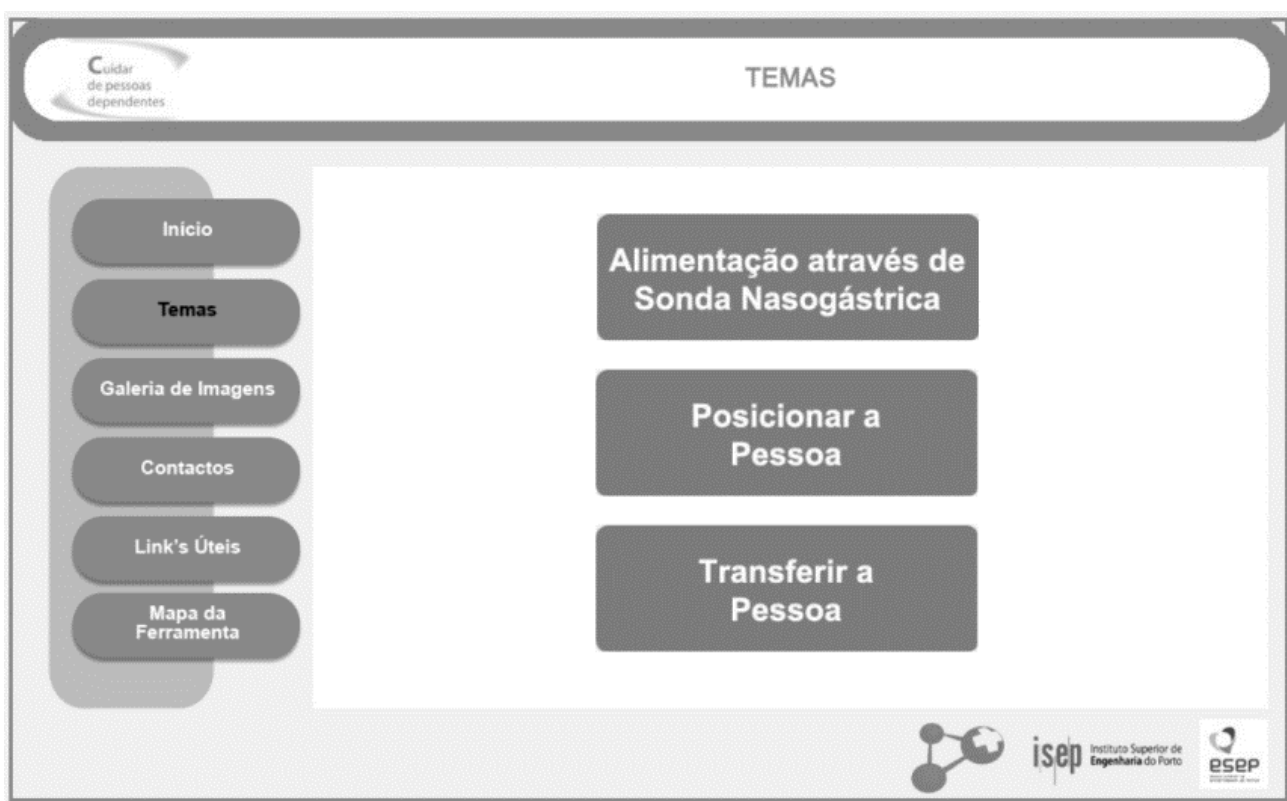
- Cuidar de pessoas dependentes = Caring for dependents;
- Cuidados a pessoas dependentes = Care for dependents;
- Início = Start;
- Temas = Themes;
- Galeria = Gallery;
- Contacto = Contato;
- Recursos multimédia = Multimedia features;
- Imagens = Images;
- Texto = Text;
- Áudio = Audio;
- Vídeos = Videos;
- Mapa conceitual = Conceptual map.

**Figure 1:** Conceptual map of interactive educational technology. Porto, Portugal, 2013.

This tool contains six different menus: start, themes, image gallery, contacts, useful links and tool map. Multimedia features (image, video, audio and text) are in all six menus. The family members acting as caregivers open the tool from an internet browser (explorer or chrome).

The accessibility and simplicity of educational technology were the main concerns; its navigation structure, divided into six menus, is:

- *Start* – Location where a brief presentation on educational technology is held.
- *Themes* – This area is divided into three parts, each corresponding to the feeding theme through nasogastric tube feeding, positioning the person and transferring the person. Each of the themes addresses the procedures that should be provided by the family members acting as caregivers (Figure 2).



**Legend:**

- Mapa de ferramenta = Tool map;
- Alimentação através de sonda nasogástrica = Nasogastric tube feeding;
- Posicionar a pessoa = Positioning the person;
- Transferir a pessoa = Transferring the person.

**Figure 2:** Page of educational technology topics. Porto, Portugal, 2013.

- *Gallery* – The image gallery is divided by the three themes. Within these themes, the images are subdivided into: 1) *Equipment*, which can be used in the chosen procedures; 2) *Procedure Images* regarding the execution of procedures in relation to the chosen theme.
- *Contacts* – The contact menu has the contact (email) of the ESEP investigator for any questions that may arise from the family members acting as caregivers.
- *Useful links* – In this area there is a set of information (links) that are useful for users to consult.
- *Tool map* – In this last area, users can access the tool's conceptual map.

## Evaluation of experts

After the construction of the educational technology, its functionality, the effectiveness of the tools and its information transmission capacity were evaluated/tested. The experts profile was defined according to age, gender, professional title, professional practice time and academic qualifications (Table 1).

**Table 1:** Characterization of the sociodemographic profile of the experts, Porto, Portugal, 2013.

Variables		N	%
Gender	Male	1	16,7
	Female	5	83,3
Age (years)	Mn	43	16,7
	Mx	53	16,7
Professional title	Associate professor	4	66,70%
	Professor coordinator	2	33,30%
Years of professional practice	Mn	20	
	Mx	32	
Academic qualifications	<b>Specialties</b>	6	
	Medical-surgical	2	33,30%
	Community health	4	66,70%
	<b>Master's degree</b>	6	
	Nursing sciences	1	33,30%
	Public Health	4	16,70%
	Economy of health	1	16,70%
	<b>Doctoral degree</b>	5	
	Nursing sciences	5	50%
	Psychology of health	2	33,30%

Table 1 shows sociodemographic data of the six experts who carried out the evaluation of the interactive tool. Five participants were female and one was male, aged between 43 and 53, the average was 49.83 years with a standard deviation 3.76. Regarding the professional practice time of the experts, the mean was 26.83 years with a standard deviation 4.3.

Table 2 shows the evaluation of the experts about the use of the interactive tool. The item related to the *relevance of the videos* showed an average of 9.6 corresponding to the most valued item, followed by the item *sequencing of the themes*, with 9.5.

**Table 2:** Experts' evaluation of the use of the interactive tool. Porto, Portugal, 2013.

Variables	Mean	Minimum	Maximum	Standard Deviation
Utility	9.5	7	10	1.2
Simple to navigate	8.8	7	10	1.5
Graphic presentation	8.3	6	10	1.5
Video quality	7.8	6	10	1.8
Video relevance	9.6	8	10	0.8
Accuracy	8.8	7	10	1.5
Audio	8.2	6	10	1.6
Time waiting	8.8	7	10	1.5
Language clarity	8.8	6	10	1.6
Themes sequencing	9.5	7	10	1.2
Interactivity	8.5	8	10	1.2
Overall rating	8.5	7	10	1.2

The *quality of the videos* item showed the lowest value, with 7.83. All items were evaluated above note



6, all of them having 10 as a maximum grade.

Regarding the detection of errors or problems, four (66.7%) experts found problems related to sound delay and the disappearance of the return indication to the homepage on the screen. The suggestions for improvement of two (33.3%) experts were language simplification and the improvement of synchronization between sound, image and text.

## DISCUSSION

The construction of this interactive educational technology followed the CID methodology. The main characteristics of a technological resource should be accessibility, self-consistency, customization, durability, ease of updating, flexibility, interactivity and interoperability<sup>(19)</sup>.

These characteristics were taken into account in the development of this educational technology. As well as, the principles of information therapy<sup>(19)</sup> aiming at "*the right information, for the right person, at the right time*". In content development, it was taken into account that the right information should be evidence-based according to the specific users needs, be current and up-to-date, free from trade bias, peer reviewed, focused on decision-making, and user friendly. The right person might be the patient, the family, and the caregiver. In our study, the provided information aimed at guiding and assisting the decision-making of family members acting as caregivers who care for dependent people, and could be a facilitator for the development of competencies. The right time refers to several moments of caring: pre-diagnosis, beginning of treatment, worsening/complications, stabilization and end-of-life care. In this case, this information would be made available to the family members acting as caregivers at the time of preparation of hospital discharge of the patient.

The resources used in virtual learning environments have a series of information available in different media, such as texts, images, videos and hypertexts, connected by links<sup>(3,20)</sup>. As well as the educational platforms<sup>(14,16)</sup> available on the internet with carefully selected links and which have a varied encyclopedia with images and videos on health topics. The technological tools selected in the *design* allowed the creation of creative and dynamic learning objects<sup>(20)</sup>, the interactive educational technology "Caring for Dependent People" contains carefully chosen links, in order to fulfil the information needs of family members acting as caregivers and present a selection of images related to the execution of the necessary procedures and equipment on the three themes related to self-care. It also presents, at the end of the procedures of each self-care, videos exemplifying these procedures. With the *Adobe Captivate 6* it was possible to integrate all interactive animations. A conceptual map is a manner of organizing and representing knowledge through graphic tools<sup>(21)</sup>. Once the usability was an initial concern of the researchers, it was defined that the navigation structure of the educational technology would be divided in six areas: start, themes, gallery, contacts, useful links and tool.

Choosing a good design and a set of colors for the interactive educational technology development is of the utmost importance. On the other hand, dark or embossed background should not be used because



they can reduce the legibility of the text. Other techniques such as the adopted language style should be simple and adapted to the usual sense; fonts such as *Arial* and *Tahoma* should be chosen because they are more readable on the screen; the sentences should be short; the content of information should be divided into areas; the amount of text per screen should be reduced, reducing the amount of text but not information<sup>(22-23)</sup>. The aggregation of several media allows, in an imaginative manner, to favor the learning by presenting diverse hypotheses of perceptive exploration, such as the visual and auditory. In the educational technology in question, there was a concern to replace the scientific language with a simpler language, not forgetting the target audience. The color used in the titles, content and links based on the color used in the research line of the master's student group, that is, orange, used in the main page of the ESEP. As for the background of the slides, the white color was chosen, except in the slides of the videos in which a gray background was used in order to provide a more pleasant visualization.

The data the experts obtained were very satisfactory and confirmed the relevance of the tool to be implemented with family members acting as caregivers. They considered it very useful and simple in navigation, with a good graphical presentation and interactivity and, according to the results, they highlighted the relevance of the videos and the sequence of the themes. Similar results can be found in other studies that have also developed a virtual learning environment<sup>(24-25)</sup>. After analyzing the questionnaires filled by the experts, the problems they found were corrected and the suggestions were integrated with the purpose of improving their quality. Similar procedures have also been found in similar studies<sup>(24-25)</sup>.

## FINAL REMARKS

The interactive educational technology "Caring for Dependent People" is a platform that aims to help family members acting as caregivers in the context of self-care to the dependent people with greater security and autonomy. This technology covers the following topics: self-care, nasogastric tube feeding, positioning and transferring. The tool contains six different menus: start, themes, image gallery, contacts, useful links and tool map. Multimedia features (image, video, audio and text) are in all six menus. The development of an interactive, reliable and user-friendly educational technology was the main innovative element as a way to help family members acting as caregivers in the development of skills and in the decision-making process. In this process, we needed to research other scientific areas, namely computer engineering, which we consider an added value. The complementarity of the knowledge, interdisciplinarity, promotes results that are more complete and adapted to the people needs. These partnerships create synergies and make tools more attractive and richer. We believe that the future will be increasingly designed in this profile. The integration of videos to help understand the recommended procedures has proved to be a very valuable resource recognized by the experts.

Taking into account the five phases of this tool construction, the development consumed a lot of time because it required coordination among several people. The tool was also the target of the evaluation of a group of experts who considered the technology interesting and confirmed its relevance to be implemented

with family members acting as caregivers. The experts positively evaluated this educational technology, giving only four items the minimum score (six). All of them scored a maximum of 10, with a minimum overall rating of seven. The suggestions and comments of the experts were essential for the improvement and reduction of possible errors that could interfere with the appropriateness and reliability of the technology.

This project aims to close the gap between advances in technological research and the practical needs of family members acting as caregivers through the development of communication and information solutions that are easily accessible via the Internet. Therefore, we consider that the objective was to provide educational technology for family members acting as caregivers that could constitute a good educational strategy, integrating a technological resource in those people training to care for dependent people.

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